

SPIE's 6th Annual International Symposium on NDE of Aging Aircraft, Airports, and Aerospace Hardware (nd02), Newport Beach, CA 3-5 March 1999

CONFERENCE TITLE: NDE of Aging Aircraft, Airports, and Aerospace Hardware (nd02)

CONFERENCE CHAIR: Ajit K. Mal, Univ. of California/Los Angeles

ABSTRACT TITLE: NDE of hidden flaws in aging aircraft structures using obliquely backscattered ultrasonic signals (OBUS)

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ABSTRACT TEXT: Corrosion is a relatively slow material degradation process to which metallic structures of aircraft are subjected during service and it can appear in many forms. Generally, corrosion protection for preventing or inhibiting the formation and growth of corrosion damage on aircraft structures is well-established technology. Unfortunately, despite preventive measures, corrosion does occur and its probability of formation significantly increases as structures age. Corrosion detection and characterization at the initiation stages, while hidden under paint or in concealed areas, is still challenging the inspection science and technology. Corrosion damage is costly and it carries the risk of loss of life as well as hardware in case of catastrophic failure. The authors are investigating the application of the obliquely backscattered ultrasonic signals (OBUS) as a method of detecting and characterizing corrosion under paint in metallic panels. OBUS were measured using oblique insonification and was successfully shown to produce image of corrosion damage on both top and bottom faces of the test panels through the paint. Initial analytical study is underway using a hybrid finite element method (HFEM) and data inversion to allow flaw characterization and imaging. The use of sensor-array real-time imaging (SARTI) is being considered, where a Charged Coupled Device (CCD) displays the inverted data. The OBUS technique can potentially reduce the need for paint stripping prior to inspection thus saving significant cost to the aircraft operators and increasing aircraft safety. Decreasing the volume of paint stripping and repainting will also have a positive environmental impact in reducing pollution and wasted resources. The ultrasonic wave interaction with the aircraft structure is analyzed assuming a multilayered medium consisting of a coated metallic panel typical to construction components of aircraft.

KEY WORDS: Ultrasonic Backscattering, NDE, Aging Aircraft, Corrosion Detection, Flaw Imaging

BRIEF BIOGRAPHY: Dr. Yoseph Bar-Cohen is a physicist with over 27 years experience in NDE, sensors, actuators and electroactive materials. He is the Jet Propulsion Lab (JPL) Resident NDE expert and the Group Leader for the NDE& Advanced Actuators (NDEAA) Technologies. Also, he is an Adjunct Professor at the Department of the Mechanical and Aerospace Engineering, the University of California, Los Angeles (UCLA), a Fellow of the American Society for NDT (ASNT) and Chair of the ASNT's Ultrasonic Committee. Dr. Bar-Cohen discovered the leaky Lamb waves and the polar backscattering in composite materials and co-pioneered their applications to NDE. He is the author of more than 135 publications, made numerous presentations at national and international symposia and holds many patents.